Requirements for Test Tool Validation

NFC Forum™

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1 Introduction

The NFC Forum Certification Program provides consistency in the behavior of NFC Forum devices by confirming that products conform to the NFC Forum device requirements.. Confirmation will be achieved through formal NFC Forum certification testing for which the development of specialized test tools will be required. To ensure that test tools are suitable for testing NFC Forum functionality, the tools will be subjected to a formal assessment or validation process conducted by an independent third-party expert, such as a laboratory or test house, selected by the Forum for this purpose.

Protocol tests are assumed to include not just data formatting but also timing. The tool validation must include the ability to verify requirements, such as Frame Response time, with a high degree of accuracy.

Once successfully validated, a tool will be deemed an NFC-Forum-approved test tool and appear on the Forum's list of approved test tools.

1.1 Audience

This document is intended for use by:

- A laboratory or test house when validating a test tool for use by NFC-Forum-recognized laboratories
- Members for testing NFC Forum Device implementations

1.2 Applicable Documents or References

[ICS]	Implementation Conformance Statement (ICS), Version 1.0, July 2010, NFC Forum
[IXIT]	Implementation eXtra Information for Testing (IXIT), July 2010, NFC Forum
[PROCESS]	Administrative Process for NFC Forum Test Tool Validation, July 2010 NFC Forum
[RFC2119]	Key words for use in RFCs to Indicate Requirement Levels, RFC 2119, S. Bradner, March 1997 Internet Engineering Task Force

1.3 Administration

The Requirements for Test Tool Validation is a document supported by the Near Field Communication Forum, Inc., located at:

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The Testing Working Group maintains this document.

1.4 Special Word Usage

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in [RFC2119].

1.5 Glossary

Engineering Sample

A prototype, commercial, or certified NFC Forum Device. In the context of test tool validation, it is a sample used to verify that the tool correctly executes a test case.

Sub-cases

A set of scenarios within a test case.

Test Case

A description of the testing of one or more requirements derived from a specification.

Test Plan

A collection of Test Cases contained in one document.

Test Script

The implementation of a Test Case into a specific test tool using a scripting language. Depending on the test tool, the Test Script can be contained in a single file, distributed over several files or be parameter driven, or it can be in text form giving the operator test instructions.

Test Suite

A set of test cases that checks a specific protocol mode/operation of the Engineering Sample being tested.

In the context of the NFC Forum Digital Protocol specifications, the test cases are: Poll NFC-A, Poll NFC-B, Poll NFC-F, Poll T1T, Poll T2T, Poll T3T, Poll T4AT, Poll T4TB, Poll P2P NFC-A, Poll P2P NFC-F, Listen NFC-A, Listen NFC-B, Listen NFC-F, Listen T1T, Listen T2T, Listen T3T, Listen T4AT, Listen T4TB, Listen P2P NFC-A, Listen P2P NFC-B, T1T Operation, T2T Operation, T3T Operation, and T4T Operation.

2 Test Tool Validation Process

For a test tool to be used for NFC Forum certification testing of NFC Forum functionality by a test laboratory, the tool must successfully complete the validation process defined by the NFC Forum. This process includes a thorough evaluation of the test tool's features, functionality, and accuracy of measurement by an independent laboratory selected by the NFC Forum for this purpose.

2.1 Validation Objectives

The primary objectives of the Test Tool Validation Process are to verify that:

- All Test Cases and Sub-cases required by the NFC Forum have been implemented in the test tool.
- The Test Cases selected by the NFC Forum have been correctly implemented on the test tool being validated, based on a Test Script review.
- Test scripts are implemented in a way that ensures that the tests can be repeated consistently.
- Executing the same set of tests on the same device yields the same test results regardless of the test tool being used, ensuring consistency across validated test tools going forward.
- The test tool implements and complies with the NFC Forum test tool requirements described in Section 3.

For more details about the Validation Objectives, see [PROCESS], Section 2.2.

2.2 Validation Process Overview

For a test tool to be approved, it must comply with the minimum requirements described in Section 3. In addition, test tools must have implemented all test cases required for a particular certification wave or phase.

After the vendor confirms that the tool complies with the NFC Forum test tool requirements and that all required test cases have been implemented correctly, the vendor works with the NFC Forum's selected laboratory to evaluate the test tool.

The laboratory evaluates the test tool based on the requirements defined in Section 2.3. After completing the process, the laboratory compiles a full evaluation report and also completes a results worksheet provided by the NFC Forum.

The NFC Forum will analyze the validation results and make an assessment as to whether the test tool can be used for testing functionality in laboratories recognized by the NFC Forum.

2.3 Test Tool Evaluation Requirements

1. The laboratory shall make a full assessment of a vendor's test tool against the requirements described in Section 3. All deviations from the NFC Forum test tool requirements, including where the test tool exceeds the requirements, must be clearly noted.

1. In addition to the requirements listed in Section 3, the laboratory shall verify that the correct number of required Test Cases are implemented in the test tool and note the number of additional test scripts not required for the certification wave.

2. The laboratory or test house shall review the test scripts for the certification wave (or phase) for correctness and efficiency against the test specifications and note any issues.

3. The laboratory or test house shall conduct and observe execution of the test cases by the test tool using prototype devices (engineering samples) provided by the NFC Forum and compare the test results with the expected outcome for any given test case.
4. After the validation process is completed, the laboratory or test house shall compile a full validation report and fill out the test tool evaluation sheet provided by the NFC Forum.

2.4 Validation Process Steps

To achieve the validation objectives, the laboratory shall perform the following three processes.

2.4.1 Desk Study

1. Review the literature/documentation provided by the tool manufacturer, which is typically the material the tool vendor would supply to a potential customer. This documentation provides all relevant information about the tool as well as instructions to set it up for operation.
2. The laboratory should familiarize itself with the tool technology, specifically the scripting of the Test Cases, based on documentation provided by the tool vendor. The test tool vendor may be required to provide training to the laboratory at a mutually acceptable date and location. The test tool vendor should provide the laboratory with telephone or email contact information if there are any questions during the evaluation.
3. Compare the Test Script with the Test Case, in particular the test objective.
4. Identify deviations of the Test Script from the Test Case.
5. Identify ambiguities in the Test Script. In particular, the laboratory should look at the set-up requirements, operator guidance, and interpretation of test results.
6. Identify ambiguities in the Test Case description (wording, parameters) compared to the test tool script.
7. Rate all instances where test tool does not yield the expected results:
    - **Severe**: Wrong test result - test script needs to be improved
    - **Moderate**: Potentially wrong test result, caused by ambiguous descriptions, varying engineering sample features, etc. Further research required.
    - **Minor**: Clarifications and recommendations required.

NOTE Appendix A shows the validation house work flow to review test scripts.

2.4.2 Validation Testing

1. Execute a complete set of test scripts applicable to the first certification wave (or phase) test cases on the engineering samples supplied by the NFC Forum.
    - Re-execute selected tests on same engineering sample to ensure repeatability of test scripts.
    - Re-execute selected tests scripts on other engineering sample(s) with different features present or absent and verify that the results match.
2. If timing is explicitly mentioned in a test case, verify that the timing is correctly implemented.
3. Evaluate the test results per test script and identify any incorrect outcomes. Provide comments and suggest improvements.
4. Evaluate the overall reporting features of the tool.
5. Evaluate the operator interface of the tool.
6. Verify that all NFC Forum Test tool requirements are fulfilled.

NOTE Appendix A shows the validation house work flows to validate test cases.

2.4.3 Reporting Results

1. Summarize the results of both the Desk Study and Validation Testing.
2. Provide assessment and rate all issues that are found.
3. Comment on the general suitability of the test tool for certification testing.
4. Provide suggestions for improving the test tool.
5. Present the final results to the NFC Forum.
6. Document all the steps followed in validating the test tool.
7. Provide a list of all correctly implemented test cases that have been validated against at least two engineering samples. (Testing against additional engineering samples may be required to cover all required test cases.)

3 Test Tool Requirements

All test tools must meet the requirements defined below. A competent third-party validation house, selected by the NFC Forum, will verify that all these requirements are met and provide the NFC Forum with the evaluation results.

1. The test tool vendor must supply an installation guide with instructions for the operating environment. If the test tool can be installed in different environments, installation instructions for all environments must be provided. The installation of any test tool software should be "automatic" by simply running an executable file.
2. The vendor must supply an operations user manual containing instructions to operate the tool. This must include a description of the operator interface and any command line executables with appropriate parameters. Files to be manually configured during testing should be kept to a minimum to help avoid human error.
3. The vendor must provide a description of the timing calibration process that was followed for the test tool and, where possible, include both a calibration certificate and report indicating the most recent calibration event. Where possible, tool schematics with details of timing outputs should also be provided.
4. The test tool must have the ability to be upgraded to support additional test cases/test scripts as new versions of the NFC Forum specifications and/or new versions of test cases are released. The test tool vendor must provide information on how scripts, firmware, and platform updates are achieved. When test scripts need to be updated, the upgrade process should occur automatically with minimal operator intervention.
5. The NFC Forum Protocol interactions and transactions must be displayed in human readable format (e.g., *not* in binary format). The tool must have the ability to store and retrieve any such content.
6. The test tool must generate a summary report of the test results and have the ability to store the report in a well-known format such as PDF. The results document must be secured so that it cannot be altered. The report should also include verdicts and comments, mainly in case of inconclusive or failed tests. A basic configuration menu could be provided to allow a user to configure the result report. The reporting menu should let users add laboratory information such as the laboratory name, technician, environmental conditions, etc.
7. The test tool must highlight test case failures and inconclusive results and must include the faulty results in a report.
8. The test tool log files must be exportable to and retrievable by a computer such as a PC.
9. The test tool must have a function to run applicable test scripts according to the provided [ICS].
10. When a certification IUT (Implementation Under Test) test plan is executed according to the [ICS], the test results and the settings, including [ICS] and [IXIT], must be stored in the test tool’s results file.
11. The test tool operator should be able to select the order of the test cases in an IUT test plan.
12. If a test tool operator executing the certification IUT test plan (according to the [ICS]) removes or adds one or more test scripts, the tool must record it clearly in the log file (e.g., TC:nnn NOT RUN, etc.).
13. The test tool must be able to accept data entered for [ICS] and [IXIT] settings for use by the tool for an IUT test plan.

14. All NFC Forum certification test scripts must be locked so that the test tool operator cannot change them.
15. The test tool must secure the final conformance results so that the test tool operator cannot make any changes.
16. The test tool must be able to check that the sequences of command/response in [IXIT] related to the indicated Type Tag Operation test cases perform the related Type Tag Operation functions, such as NDEF Read.

In addition to the above test tool requirements, the following recommendations should be considered for easier results analysis:

1. Generate test logs with the basic information about the test case in the header (name, identifier, objective, basic configuration, and tool verdict).
2. Map each command and response in the communication to the corresponding step in the test plan.
3. Identify any requirement of the pass criteria that has to be checked during log generation.
4. Highlight any failure detected during test case execution and include error messages where possible.

A. Validation Process Flows

A.1 Desk Study: Test Scripts Review

Figure 1 illustrates the workflow for each test suite.

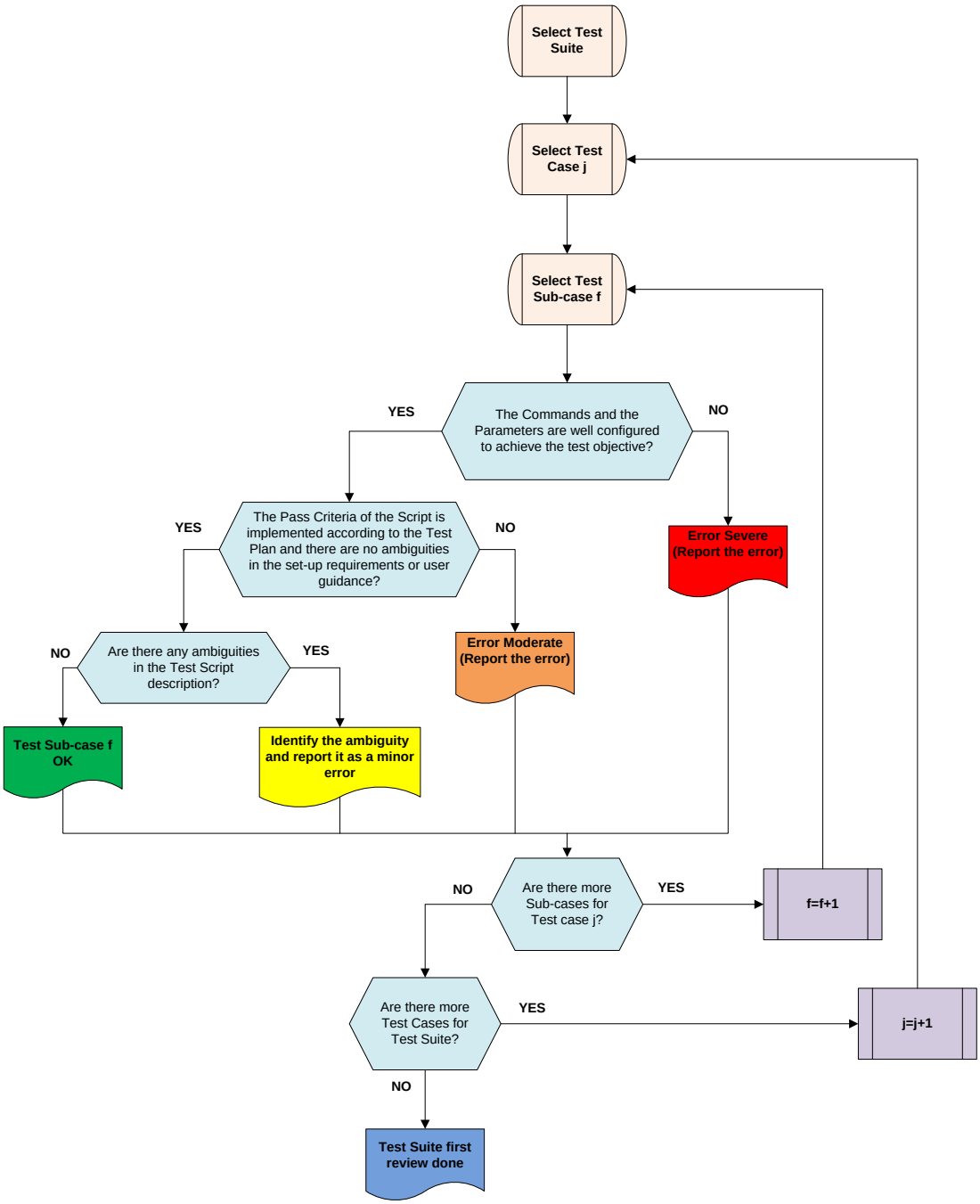

Select Test Suite
Select Test Case j
Select Test Sub-case f
The Commands and the Parameters are well configured to achieve the test objective?
YES
NO
The Pass Criteria of the Script is implemented according to the Test Plan and there are no ambiguities in the set-up requirements or user guidance?
YES
NO
Error Severe (Report the error)
Are there any ambiguities in the Test Script description?
NO
YES
Error Moderate (Report the error)
Test Sub-case f OK
Identify the ambiguity and report it as a minor error
Are there more Sub-cases for Test case j?
NO
YES
f=f+1
Are there more Test Cases for Test Suite?
YES
j=j+1
NO
Test Suite first review done

Figure 1: Test Script Review Flow

Note that a test script is considered successfully validated only if the test case and all its sub-cases were successfully executed.

Before sending a report to the tool manufacturer, the laboratory will cross-verify any errors as shown in Figure 2:

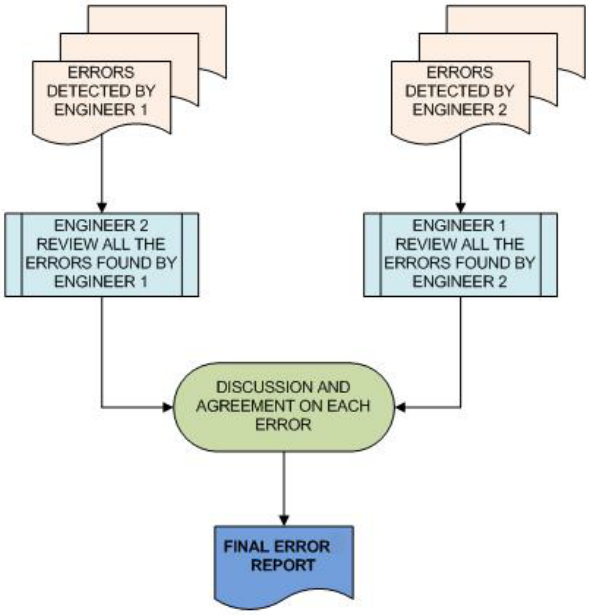
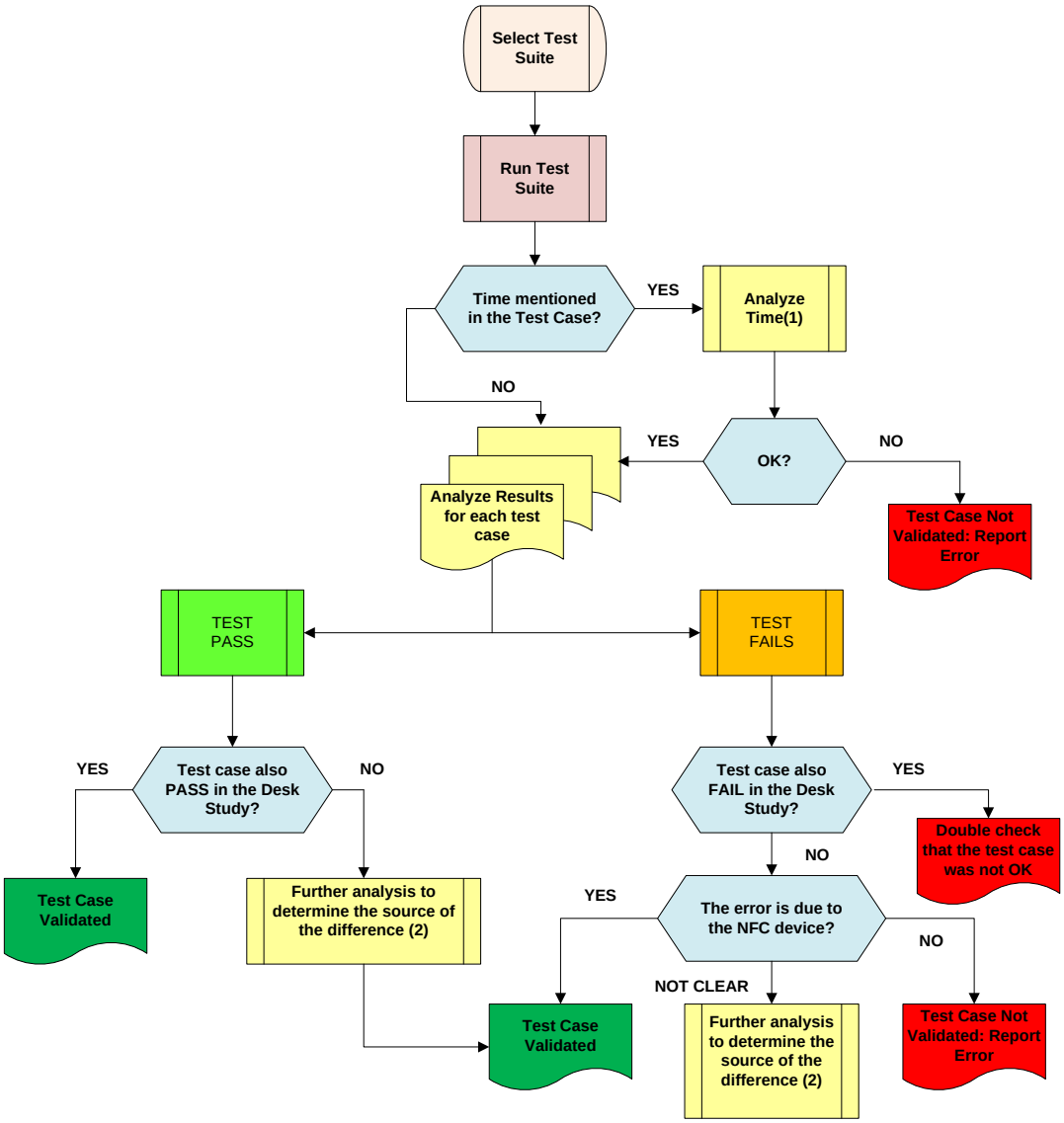

ERRORS DETECTED BY ENGINEER 1
ERRORS DETECTED BY ENGINEER 2
ENGINEER 2 REVIEW ALL THE ERRORS FOUND BY ENGINEER 1
ENGINEER 1 REVIEW ALL THE ERRORS FOUND BY ENGINEER 2
DISCUSSION AND AGREEMENT ON EACH ERROR
FINAL ERROR REPORT

Figure 2: Error Cross-verification Flow

After all errors have been cross-verified, the laboratory will inform the tool manufacturer of any errors for resolution while continuing with the next phase of the validation process.

A.2 Validation Testing: Test Cases Validation

Figure 3 depicts the procedure to be followed during this step. It is important to note that each test suite will be run using no fewer than two NFC Forum devices, with two test engineers analyzing the results.



(1) Analyze time based on timing measurement functionality of the test tool

(2) The results of two NFC devices will be compared to facilitate better analysis. If possible, the results will be compared against other validated test tools.

Figure 3: Validation Testing Flow

B. Revision History

The following table provides the revision history of Requirements for Test Tool Validation.

Table 1: Revision History

Document Name	Revision & Release Date	Status	Change Notice	Supersedes
Requirements for Test Tool Validation	Version 1.0, July 2010	Final		
Requirements for Test Tool Validation	Version 1.1, September 2010	Final		Version 1.0